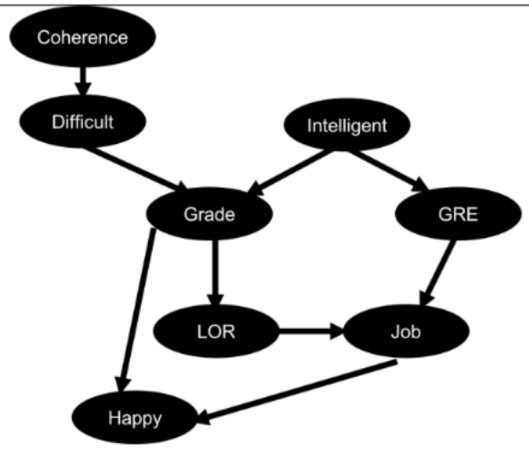
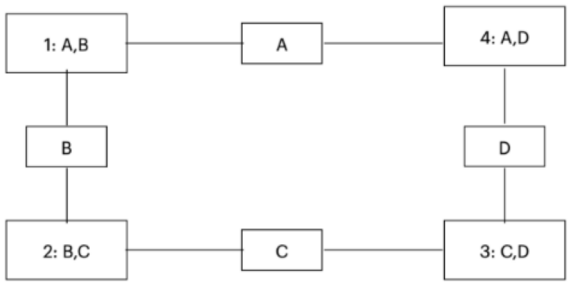
SVKM's
D. J. Sanghvi College of Engineering

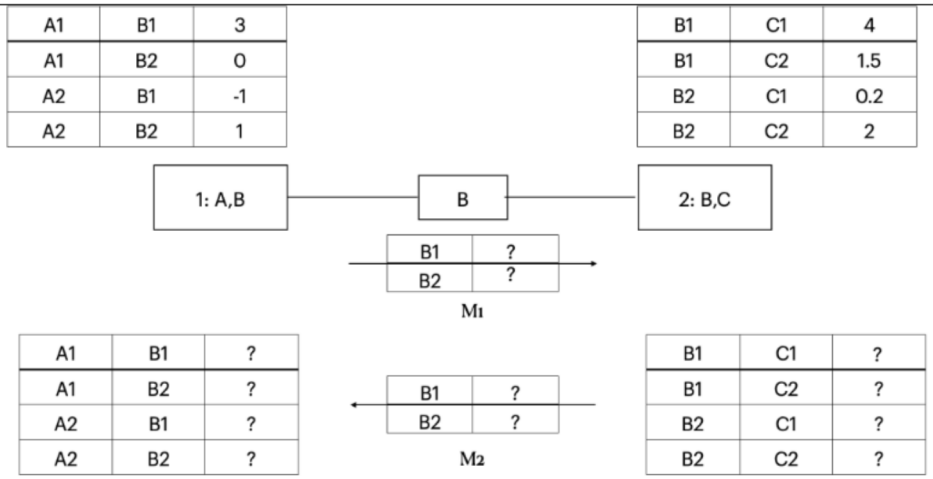
Program: B.Tech in Comp. Sci. and Eng.(Data Science) **Academic Year: 2022** **Duration: 3 hours**
Date: 12.01.2023
Time: 10:30 am to 01:30 pm
Subject: Probabilistic Graph Models (Semester V) **Marks: 75**

REGULAR EXAMINATION

Instructions: Candidates should read carefully the instructions printed on the question paper and on the cover page of the Answer Book, which is provided for their use.
(1) This question paper contains 03 pages.
(2) All Questions are Compulsory.
(3) All questions carry equal marks.
(4) Answer to each new question is to be started on a fresh page.
(5) Figures in the brackets on the right indicate full marks.
(6) Assume suitable data wherever required, but justify it.
(7) Draw the neat labelled diagrams, wherever necessary.
(8) Mention **correct question number** in the answer sheet.

Question No.		Max. Marks
Q1 (a)	1. Difference between Bayesian and Markovian representations. 2. Assume that A and B are independent random variables. Which of the following options are always true? Give reason. a) P(A,B) = P(A) * P(B) b) P(B/A) = P(B) c) P(A) + P(B) = 1 d) P(A,B) = P(A) + P(B)	[05] [02]
Q1 (b)	 Graph 1	[08]

	What are the conditions of an Active Trail in Bayesian Network? Give reasons which of the following are active trail if Grade is observed in graph 1? 1. Intelligent → GRE→ Job→ Happy 2. Coherence → Difficult → Grade ← Intelligent → GRE →Job ← Letter 3. Intelligent → Grade → Letter → Job → Happy 4. Coherence → Difficult → Grade ← Intelligent → GRE	
Q2 (a)	1. If P factorizes over G and d-sepG (XY| X) then P satisfies (X ⊥Y|Z)	[07]
	OR	
Q2 (a)	2. What is the advantage of **Conditional Random Field** in representing high dimensional data? Take any two real world examples and explain.	[07]
Q2 (b)	1. What is a Markov assumption? Discuss a situation where this assumption is not true. So how to modify it in order to make the assumption true.	[08]
	OR	
Q 2 (b)	2. Discuss a speech recognition system using Hidden Markov Model (HMM).	[08]
Q3 (a)	Derive the complexity of variable elimination.	[05]
Q3 (b)	Can we guarantee regularity in Gibbs Sampling on XOR for all conditions? Justify your answer.	[05]
Q3 (c)	In the shown message passing process (graph 2), what would be the right definition for messages: (1) δ1,2, (2) δ 4,3, (3) δ 2,3, (4) δ 2,1 and (5) δ 4,1  Graph 2	[05]
Q4 (a)	What is a Clique Tree? Define **Max-Sum in Clique Tree**. What are the **convergence criteria** of message passing in a clique tree? Shown below is a message passing for a given clique tree. Fill in the blanks (?) considering **max marginalization.**	[10]

	 Graph 3	
Q4 (b)	1. Discuss the limitations of the bounds.	[05]
	OR	
Q4 (b)	2. Discuss the Pros and Cons of Markov Chain Monte Carlo (MCMC) Method.	[05]
Q5 (a)	1. How do we perform maximum likelihood function in case of Bayesian Network and Markov Network if there is missing data issue in the given dataset?	[10]
	OR	
Q5 (a)	2. Explain Tree-Augmented Naïve Bayes (TAN) and its application in Chow-Liu algorithm.	[10]
Q5 (b)	What are the various sufficient statistics used for maximum likelihood estimators?	[05]